



DEPARTMENT OF TRANSPORTATION AND ENVIRONMENTAL SERVICES

2900-B Business Center Drive
Alexandria, Virginia 22314
alexandriava.gov

April 17, 2015

Bryant Thomas
Regional Water Permits and Planning Manager
Virginia Department of Environmental Quality
Northern Regional Office
13901 Crown Court
Woodbridge, VA 22193

Subject: City of Alexandria – Long Term Control Plan Update Technical Memorandums

Dear Mr. Thomas:

Thank you for your review of our initial technical memoranda, as summarized in your April 1, 2015 letter to the City. We appreciate VDEQ's feedback and collaboration during the City's Long Term Control Plan Update (LTCPU) planning process. We hope this letter answers the requests for additional information as requested in your April 1st letter. As discussed during our January 2015 meeting, we are targeting a follow-up meeting in May to present a shortlist of alternatives that will be potentially considered for detailed evaluation. Detailed responses to the issues and questions raised in your April 1st letter are provided below.

- 1) Use of 1984 as a model simulation year. Your letter states that, "Of concern is by employing 1984 as a model simulation year, there is no bacteria water quality modeling data for which to calibrate and validate a water quality model."

Response: The City would like to clarify that the water quality modeling is not being conducted using 1984 as a simulation year, but is using the TMDL years of 2004-2005. The water quality modeling is being conducted by first determining the sizing of potential CSO controls and applying that level of control to the TMDL years (2004-2005) to determine the impact on water quality. At this stage of the update, there are two levels of control being evaluated. The first is based on CSO Control Policy of 4-6 overflows per year based on a typical year. The second is based on the level of control required to meet the reductions stated in the Hunting Creek TMDL.

- 2) Climate Change. Your letter asks that the City consider the impact of climate change in the design and analysis of CSO control strategies

Response: With regards to climate change, there is nothing in the CSO policy that requires the City to address climate change; however, the City has been forward thinking in this area. In 2011, the City commissioned a study of rainfall intensity and climate change. The City will consider these impacts in the LTCPU planning process.

- 3) Design Storm Events. Your letter asked to present the typical year characteristics of 1984 in terms of design storm events.

Response: Per your request we have reviewed key storms from the *Typical Year Selection Technical Memorandum* and plotted them based on the IDF curves generated from NOAA data (Attachment 1). Alternatively, we have also determined the return period using the 40 years of data (Attachment 2) from the *Typical Year Selection Memorandum*. As the City is using a target of 4 overflows per year for the initial alternatives screening, we have identified the fourth and fifth largest storms.

As Table 1 summarizes, the storms in 1984 have a higher return period when they are based on the City's IDF curve generated NOAA data. Alternatively, the Weibull Return Period supports that the fourth and fifth largest storms in 1984 are representative of the entire 40-year dataset. This is demonstrated by the fact that the 4th largest storm for any typical year should occur 4 times per year, or once every 3 months. Since the Weibull Return Period analysis shows that the 4th largest storm in 1984 has a return period of 3-months, this indicates that it represents the 40-year dataset well. This analysis also illustrates that the 2004-2005 TMDL period is not representative of typical conditions because the largest storm has a return period of 67 years and represents the second largest storm event of the entire 40 year period.

Table 1: Storm Return Period

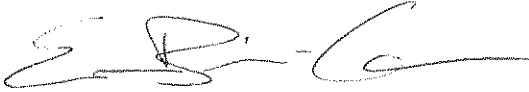
Year	Event	Rainfall (in)	Duration (hrs)	NOAA IDF Return Period ¹	Weibull Return Period ²
1984	Fifth Largest Storm	1.58	27	7-month	3-month storm
1984	Fourth Largest Storm	1.59	30	7-month	3-month storm
2005	Largest Storm (October)	7.30	39	43-year	67-year storm

¹ Return period interpolated from the Alexandria IDF curves developed in Atlas 14, Volume 2, Version 3. See Attachment 1.

² Weibull Return Period based on 40 years used in the *Typical Year Selection TM* (1974-2013). See Attachment 2.

The City is proceeding with the evaluation of alternatives using the typical year of 1984, the TMDL period, as described in the *Regulatory Requirements Technical Memorandum*. We look forward to furthering our discussions in May. We will be contacting you soon to schedule the meeting.

Sincerely,

A handwritten signature in black ink, appearing to read 'E. Bevis-Carver', with a long horizontal flourish extending to the right.

Erin Bevis-Carver, P.E.

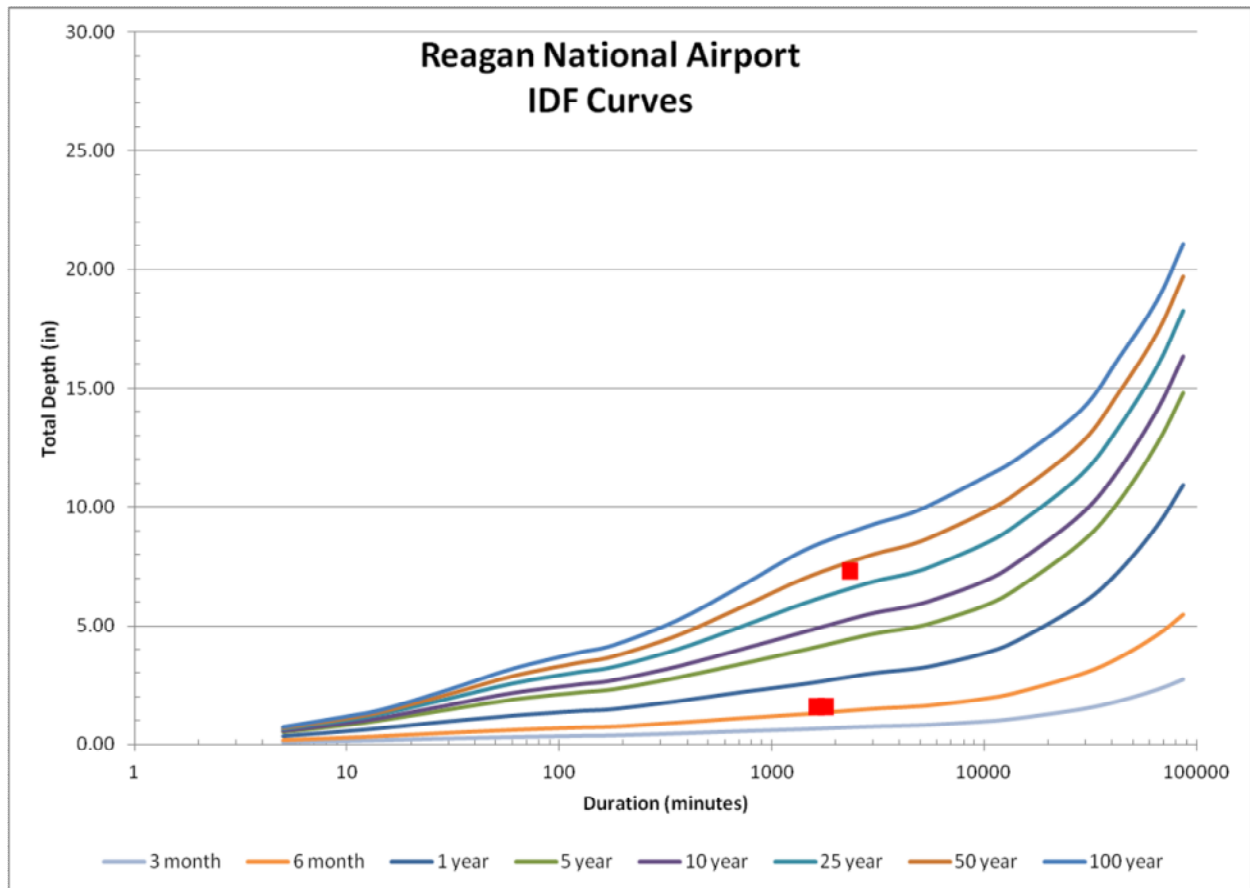
Sanitary Section Lead, T&ES – Stormwater and Sanitary Infrastructure Division

CC: William Skrabak, Deputy Director, T&ES - Infrastructure and Environmental Quality
Lalit Sharma, P.E., T&ES - Stormwater and Sanitary Infrastructure Division

Attachment 1

NOAA Alexandria IDF Curves

Storm Event	Description	Duration (hours)	Total Depth (in)	Return Period
9/30/1984	5 th Largest Storm in 1984	27	1.58	7-month
3/25/1984	4 th Largest Storm in 1984	30	1.59	7-month
10/7/2005	Largest Storm in 2005	39	7.30	43-year



Attachment 2

Weibull Return Period

The Weibull Return Period is a statistical method of calculating the return period of any wet weather event in a given dataset. Using the same 40-year dataset (1974-2013) as presented in the *Typical Year Selection Technical Memorandum*, all of the wet weather events in this dataset were ranked in order from the largest event to the smallest event. The largest event was assigned a rank of 1 and the smallest event a rank of 4,025. The formula below is then used to calculate the return period for each event.

$$\text{Weibull Return Period} = \frac{NMY + 1 - 2A}{M - A}$$

NMY = 40 = number of years

M = event rank in descending order

A = 0.4 = Weibull Position Parameter

Weibull Position Parameter

The parameter for return period calculation is dimensionless. A value of A = 0 gives the familiar Weibull plotting position, often used in hydrology, but criticized by Cunnane (1978) who suggested a value of A = 0.4 as a good compromise for the customary situation in which the underlying frequency distribution of the parameter is unknown.

Example:

The 5th largest storm in 1984 had a total depth of 1.58” and ranked as the 147th largest event over the entire 40-year rainfall record. Using the equation above:

$$\text{Weibull Return Period} = \frac{40 \text{ years} + 1 - (2 * 0.4)}{147 - 0.4} = \frac{40.2}{146.6} = 0.27 \text{ year event} \\ \cong 3 \text{ month event}$$

Storm Event	Description	Duration (hours)	Total Depth (in)	Rank	Weibull Return Period
9/30/1984	5 th Largest Storm in 1984	27	1.58	147	3-month
3/25/1984	4 th Largest Storm in 1984	30	1.59	152	3-month
10/7/2005	Largest Storm in 2005	39	7.30	1	67-year